Remarks

Novelty [Article 33(2) PCT]

The Examiner is of the opinion that the claims as filed lack novelty over each of the following documents:

D1: WO 01/64985 (MarCanada Inc.)

D2: US 2,884,018 (Delcellier & Weinberger)

D3: WO 00/57738 (Bekaert S.A.)

These documents will be considered in turn.

D1: WO 01/64985 (MarCanada Inc.)

D1 discloses a textile material to form an outer shell fabric for fire-resistive garments, the textile material being a textile arrangement of at least first and second inherently fire-resistant yarns, the first and second yams being different from one another, the textile arrangement including interlacing means joining the first and second yarns.

The Examiner considers that D1 discloses a fabric in which pockets are formed. The Applicant submits that D1 does not disclose pockets. With reference to Figure 2 of D1, what is disclosed is an arrangement whereby two separate layers of fabric (3, 6) are attached together at various points by interlacing of intermittent warp yarns (4). The result is not pockets but rather two surfaces of fabric with an open layer between them, extending in all directions. In contrast, in the fabric of the invention, two plies are assembled so as to form closed pockets.

To clarify this distinction, Claim 1 has been amended to specify that the pockets in the fabric of the invention are ***closed, adjacent*** pockets.

D1 does not disclose a fabric having closed, adjacent pockets. Claim 1 is novel over D1.

The points mentioned above with relation to Claim 1 apply equally to dependent Claims 2 to 18. Dependent claims 2 to 18 are also novel over D1.

The garment defined by Claims 19-23 comprises the novel fabric of the invention, and hence is novel.

D2: US 2,884,018 (Delcellier & Weinberger)

D2 discloses a cloth for use as a protection against radiant or conducted energy emanating from a heat source. The cloth comprises a plurality of layers of large gauge weftwise extending fillers bound in place by a plurality of intersecting woven binding fabrics forming at least an outer layer and an inner layer of fabric (D2: column 1, lines 15-17 and 61-65).

D2 does not disclose a fabric having closed pockets. Figures 1-4d of D2 show warpwise cross-sections of cloth (i.e. cut across the weft) in which fillers (51, 52) are interwoven with binding fabrics (53, 54, 55). It is clear from the Figures and the description of D2 that the filler fibres extend in the weftwise direction of the cloth (see, for example, column 2, lines 69-70). The fillers are thus encased in "sheaths" of fabric which extend infinitely in the direction of the weft, and which are open at the ends. These sheaths are not closed pockets.

D2 does not disclose a fabric comprising at least two separate plies being assembled together at predetermined positions so as to build closed, adjacent pockets, as defined by Claim 1. Claim 1 is novel over D2.

The points mentioned above with relation to Claim 1 apply equally to dependent Claims 2 to 18. Dependent claims 2 to 18 are also novel over D2.

The garment defined by Claims 19-23 comprises the novel fabric of the invention, and hence is novel.

D3: WO 00/57738 (Bekaert S.A.)

D3 discloses a heat-resistant garment having an outer surface mainly comprising metal fibres to provide a resistance against contact heat.

In some embodiments, the garment of D3 may comprise multiple layers of fabric (see for example Figure 2 of D3), however these layers are not assembled to build closed pockets.

D3 does not disclose a fabric comprising at least two separate plies being assembled together at predetermined positions so as to build closed, adjacent pockets, as defined by Claim 1. Claim 1 is novel over D3.

The points mentioned above with relation to Claim 1 apply equally to dependent Claims 2 to 18. Dependent claims 2 to 18 are also novel over D3.

The garment defined by Claims 19-23 comprises the novel fabric of the invention, and hence is novel.

Inventive step [Article 33(3) PCT]

The Applicant has chosen to argue using the problem-solution approach. The expression "closest prior art" is not an admission of the particular relevance of any document.

The present invention, as defined by amended Claim 1, provides a heat, flame and electric arc resistant fabric, comprising at least two separate plies, the two separate plies being assembled together at predefined positions so as to build closed, adjacent pockets.

The provision of closed pockets leads to superior heat, flame and electric arc resistance as compared with conventional fabric. In the case of thermal exposure, the ply of the fabric which is exposed to the elevated temperature will shrink so that the fabric pocket will swell and form partially air-filled chambers which insulate the wearer from the environment. The dead air (i.e. entrapped) space is automatically produced when needed during critical situations, thus improving the thermal performance of the fabric, without increasing its specific weight. The excellent performance of fabrics according to the invention is exemplified in Examples 1 to 6.

None of the prior art documents, either alone or in combination, teach or suggest the fabric of the invention.

D1 as "closest prior art"

D1 discloses a fabric having two plies, the plies being attached to each other at isolated points, or along lines (see Figure 2 of D1). Starting from D1 as the "closest prior art", the problem to be solved is to provide a fabric of improved heat, flame and electric arc resistance. The solution provided by the inventors of the present invention, is to provide closed, adjacent pockets between the at least two plies of the fabric. The provision of pockets results in the formation of dead air spaces on exposure to heat, which insulate the wearer from the heat source.

D1 does not teach or suggest to assemble at least two plies of fabric to build closed, adjacent pockets. Instead, D1 discloses that two fabric plies are to be attached to each other at isolated points, creating a "space" between the two plies that extends the entire width and breadth of the fabric. Because the space between the fabrics in D1 is not closed, it is not possible to form a dead air space. In fact, if an air space were formed between the plies of the fabric of D1 on exposure to heat (as is suggested on page 8, at lines 24-25), heat transfer would occur by convection, due to the essentially unhindered movement of air within the air space between the fabric plies.

In contrast, in the fabric of the invention, movement of air between the fabric plies is essentially eliminated, because of the provision of closed pockets. This reduces heat transfer by convection and increases the insulating capability of the fabric.

In the fabric disclosed in D1, because the "space" between fabric layers extends essentially the width and breadth of the fabric, it is not possible to "inflate" pockets of entrapped dead air. On heating, air will simply escape out the sides of the fabric. It is also not possible to create pockets of entrapped air by uneven shrinkage of the fabric, since the layer between the fabric layers is open.

In contrast, with the fabric of the invention, on exposure to heat, the closed pockets will "inflate" leading to a dual insulation effect. The pockets themselves, having entrapped dead-air, act as insulation between the heat source and the wearer. In addition, the "inflation" of the pockets pushes the fabric away from the wearer's skin, resulting in the formation of an additional insulating layer, inside the garment, next to the wearer's skin.

Furthermore, with the arrangement disclosed in D1, damage to a very small area of the outer layer of fabric would "open up" the second layer over the entire fabric. Heat and flame would then be able to enter between the layers of fabric across the entire surface of the fabric, quickly leading to destruction of the rest of the cloth. In contrast, with the fabric of the invention, damage to a small area of the outer surface will open only pockets within the vicinity of the damage, while the rest of the fabric will maintain its insulating pocket structure.

D1 does not teach or suggest the provision of closed pockets, nor the advantages which result from the provision of closed pockets. Claim 1 is inventive over D1, whether D1 is taken alone or in combination with other documents.

The points mentioned above with relation to Claim 1 apply equally to dependent Claims 2 to 18. Dependent claims 2 to 18 are also inventive over D1.

The garment defined by Claims 19-23 comprises the inventive fabric of the invention, and hence is inventive.

D2 as "closest prior art"

D2 discloses a heat resistant woven cloth comprising a plurality of layers of large gauge weftwise extending fillers bound in place by a plurality of intersecting woven binding fabrics forming at least an outer layer and an inner layer of fabric (D2: column 1, lines 15-17 and 61-65). Starting from D2 as the "closest prior art", the problem to be solved is to provide a fabric of improved heat, flame and electric arc resistance. The solution provided by the inventors of the present invention, is to provide closed, adjacent pockets between the at least two plies of the fabric. The provision of pockets results in the formation of dead air spaces on exposure to heat, which insulate the wearer from the heat source.

D2 does not teach or suggest this solution. The fillers (51,52) of D2 extend the length of the weft, and the fabric layers (53, 54 and 55) surround the fillers, forming sheaths around them, also extending the length of the weft. There is no teaching or suggestion of the provision of closed pockets which can provide insulating dead air space on exposure to heat.

A proposed mechanism of heat dissipation in the fabric of D2 is discussed in column 3, at lines 64-73:

> *As the filler of acrylic fibre is consumed it absorbs heat and the gas which is developed dissipates into the atmosphere thereby automatically carrying heat out of the cloth, and moreover displacing oxygen-containing air so as to serve as a flame extinguisher and to prevent the protected matter next to the cloth from bursting into flames although the temperature margin of the flash point has been exceeded. On disintegration of the acrylic fibre, there remain gas or air pockets which contribute substantially to the thermal insulation properties of the cloth.* (D2: column 3, lines 64-73)

While there is mention made of "pockets" in D2, these are not closed pockets, as required by the invention, but would rather be "channels" extending the length of the weft. These channels would be formed upon disintegration of the filler (51, 52) within the fabric sheaths. Because these channels are essentially open at the ends, they do not form an insulating dead air space.

Furthermore, damage to a small area of an outer layer of the fabric of D2 would open up an entire channel extending the length of the weft. Heat and flame would then be able to enter and spread through the entire channel, quickly leading to destruction of the rest of the cloth. In contrast, with the fabric of the invention, damage to a small area of the outer surface will open only pockets within the vicinity of the damage, while the rest of the fabric will maintain its insulating pocket structure.

D2 does not teach or suggest the provision of closed pockets, nor the advantages which result from the provision of closed pockets. Claim 1 is inventive over D2, whether D2 is taken alone or in combination with other documents.

The points mentioned above with relation to Claim 1 apply equally to dependent Claims 2 to 18. Dependent claims 2 to 18 are also inventive over D2.

The garment defined by Claims 19-23 comprises the inventive fabric of the invention, and hence is inventive.

D3 as "closest prior art"

D3 discloses a heat-resistant garment having an outer surface mainly comprising metal fibres to provide resistance against contact heat. Starting from D3 as the "closest prior art", the problem to be solved is to provide a fabric of improved heat, flame and electric arc resistance. The solution provided by the inventors of the present invention, is to provide closed, adjacent pockets between the at least two plies of the fabric. The provision of pockets results in the formation of dead air spaces on exposure to heat, which insulate the wearer from the heat source.

D3 does not teach or suggest this solution. A proposed mechanism of heat dissipation for the fabric of D3 relies on the conductivity of the metal fibres, and is described on page 5, at lines 28-31:

> *The thermal energy will preferably be conducted to areas of the heat-resistant garment surrounding the contact points, since the fibres, mostly lying parallel to the surface of the heat-resistant garment, will conduct the thermal energy thanks to the good thermal conductivity.* (D3: page 5, lines 28-31]

This mechanism (conduction) is entirely different from that of the fabric of the invention, which is based on the formation of dead air space within closed fabric pockets (insulation). There is nothing in D3 to teach or suggest that the provision of closed pockets will result in a fabric having excellent heat, flame and electric arc resistance. Claim 1 is inventive over D3, whether D3 is taken alone or in combination with other documents.

The points mentioned above with relation to Claim 1 apply equally to dependent Claims 2 to 18. Dependent claims 2 to 18 are also inventive over D3.

The garment defined by Claims 19-23 comprises the inventive fabric of the invention, and hence is inventive.

Conclusion

The claims have been amended for the sake of clarity. The amended claims are both novel and inventive over the prior art.

Very truly yours,

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